



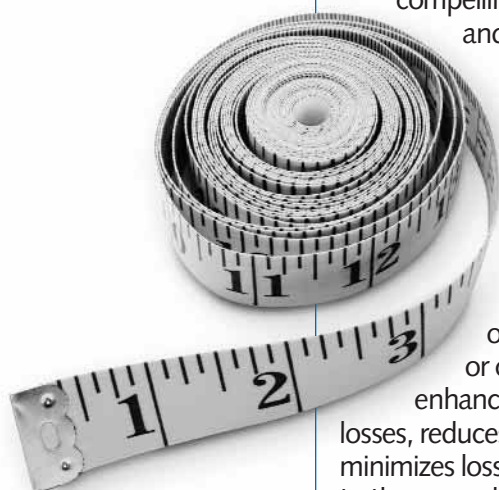
Dairy Council

DIGEST

November | December 2005

Volume **76**
Number **6**

3-A-DAY OF DAIRY FOR A HEALTHY WEIGHT



3 servings of dairy a day in a reduced-calorie diet supports weight loss.

SUMMARY

Not only is a substantial proportion of Americans overweight or obese, but many are also undernourished. For example, many Americans fail to consume recommended amounts of calcium, primarily because of their low intake of dairy products. Although consuming too many calories in relation to energy expenditure is the primary determinant of overweight/obesity, a growing body of scientific research suggests that adequate calcium and dairy food intake may contribute to a healthy body weight.

Recently conducted randomized clinical trials (considered the "gold standard" of science) in adults provide the most compelling evidence for calcium's and dairy's beneficial role in the prevention and treatment of obesity. In these clinical trials of overweight or obese adults (males, females, whites, African Americans) following reduced-calorie diets, increasing consumption of dairy foods (milk, yogurt, or cheese) to 3 servings/day enhances body weight and body fat losses, reduces central (trunk) obesity, and minimizes loss of lean body tissue compared to the same degree of energy restriction while consuming little or no dairy.

Dairy sources of calcium may exert a greater "anti-obesity" effect than calcium alone. In addition, a recent clinical trial in African American adults found that consuming 3 servings of milk, cheese, or yogurt/day not only enhanced body weight/fat loss and helped preserve lean body mass when dieting, but also improved body composition (i.e., reduced total body and trunk fat and increased lean body mass)

and metabolic profile during weight maintenance compared to low intakes of dairy products.

Further support for a role of calcium and dairy products in weight management in adults comes from observational studies, although factors such as the level of baseline calcium or dairy intake, gender, and race appear to influence this relationship. Research from *in vitro* and experimental animal studies suggests potential mechanisms whereby dietary calcium and other components in dairy products may regulate energy metabolism and thereby reduce obesity risk.

The goal of weight management for overweight children and adolescents is to slow the rate of weight gain while achieving normal growth and development. Compared to studies in adults, relatively little research has examined the relationship between calcium or dairy intake and body weight/body composition in children and adolescents. Moreover, most of the studies are observational, which cannot prove a cause and effect relationship. In general, these studies suggest that increasing dietary calcium/dairy intake to recommended levels may play a role in promoting a healthy body weight, lowering the percentage of body fat, or preventing an unhealthy weight gain in children and adolescents.

Additional research is needed to clearly establish the underlying mechanisms and to further understand dairy's role in weight management. However, this emerging benefit of dairy products in helping to achieve and maintain a healthy body weight provides one more reason why Americans should be encouraged to consume recommended servings of milk, cheese, or yogurt a day within appropriate energy levels.



The Dairy Council Digest® is available on-line.
www.nationaldairycouncil.org

INTRODUCTION

Overweight and obesity in the U.S. have risen dramatically in the past 20 years and are now considered a great public health concern (1,2). Nearly two-thirds (65.1%) of adults 20 years of age and older are overweight (body mass index or BMI of 25 to 29.9 kg/m²) or obese (BMI of 30 kg/m² or greater) (3). Among children aged 6 through 19 years, 16% are overweight and an additional 15% are at risk for overweight (3). Overweight and obesity are associated with increased risk of major chronic diseases such as coronary heart disease, hypertension, stroke, type 2 diabetes mellitus, and some cancers, as well as excess mortality (1,2,4,5).

A positive energy balance or excess calorie intake relative to energy expenditure leads to overweight and obesity. To reverse the trend toward obesity, most Americans need to consume fewer calories, increase their physical activity, and make wiser food choices (2).

Not only are many Americans overweight or obese, but many are also undernourished. For example, many Americans fail to meet calcium recommendations largely because of their low intake of dairy products (6,7). Males and females 20 years and over are only consuming 1.8 and 1.4 servings of dairy/day, respectively, compared to the current recommendation of 3 cups of low fat or fat-free milk or equivalent milk products (e.g., cheese, yogurt) a day (2,7). Dietary calcium intake is most often considered in terms of promoting bone health (8). However, a growing body of scientific research indicates that calcium and particularly dairy foods may also play a role in improving body weight and/or body composition.

This emerging research on calcium's and dairy's role in both the prevention and treatment of obesity is discussed in several reviews (9-16). The current body of research includes randomized clinical trials (considered the "gold standard" of science) and observational, animal and cellular studies. This *Digest* reviews new research findings related to calcium or dairy food intake and body weight/body fat in adults and children. Emphasis is placed on studies – particularly randomized clinical

Reducing and preventing overweight and obesity is a public health priority.



trials in adults and some new observational investigations in adults and children – published since a previous *Digest* on this topic (17).

DAIRY AND WEIGHT MANAGEMENT IN ADULTS

The goal for adults is to achieve and maintain a body weight that optimizes their health (2). For obese adults, even modest weight loss (e.g., 5 to 10% of body weight) has health benefits and the prevention of further weight gain is very important.

Randomized Clinical Trials. In the past two years, several randomized clinical trials have demonstrated that overweight or obese adults who consumed recommended daily intakes of calcium/dairy products as part of a balanced calorie-restricted diet lost significantly more body weight and body fat than those who consumed a balanced reduced-calorie diet with little or no dairy foods. This finding has been demonstrated in both males and females, whites and African Americans (18-20). Including dairy foods in the diet also helps to preserve lean body mass during weight loss and increase lean body mass during weight maintenance (19,20). Research shows that dairy foods exert a significantly greater effect on body weight and body fat compared to calcium supplements or low-dairy diets (18).

In a 24-week randomized, placebo-controlled study of 32 obese adults, those who consumed 3 servings/day of milk, yogurt, or cheese while on a balanced, reduced-calorie diet (500 calorie deficit) lost significantly more body weight and fat than those who consumed similar amounts of calcium through supplements or consumed little or no dairy (18). This was the first clinical trial directly comparing diets high in calcium from dairy foods to diets high in calcium from supplements. Subjects were randomized to a low calcium/low dairy control diet (0-1 servings of dairy foods/day or 400 to 500 mg calcium/day), a high calcium supplemented diet (control diet supplemented with 800 mg calcium/day), or a high dairy food diet (3-4 servings of dairy foods/day, total calcium intake of 1,200 to 1,300 mg/day). Weight loss was almost 15 pounds (6.6 kg) for the low

calcium group (6% of total body weight), 19 pounds (8.6 kg) for the high calcium group (9% of total body weight), and 24 pounds (11.1 kg) for the high dairy group (11% of total body weight) (18). A similar trend was found for losses of body fat and trunk fat (including fat around the abdomen which is associated with adverse health effects).

Another randomized clinical trial found that consuming 3 servings of yogurt/day as part of a reduced-calorie diet enhanced body weight and fat losses, reduced central obesity, and minimized loss of lean body tissue (19). Thirty-four healthy obese adults were placed on a balanced 500 calorie-deficit diet and randomly assigned to either a control diet providing 0-1 servings of dairy products/day (400 to 500mg calcium/day) or the yogurt diet (3 six-ounce servings/day of fat-free yogurt which supplied 1,100mg/day of total calcium) for 12 weeks. Participants in the yogurt group lost 22% more body weight than those in the control group (~ 15 pounds vs ~ 11 pounds) and 66% more body fat than those in the control group (~ 10 pounds vs 6 pounds) (19). Compared to the control group, those in the yogurt group lost 31% less lean body tissue and 81% more trunk fat (as indicated by a significantly smaller average waist circumference) during the 12-week study (19).

Two separate randomized clinical trials (one for weight loss, the other for weight maintenance) in obese African American men and women found that a dairy-rich diet enhanced body weight and fat losses when dieting and improved body composition during weight maintenance (20). For both 24-week studies, participants were randomly assigned to one of two diets: a low dairy diet (0-1 dairy servings/day; 500mg/day of calcium) or a high dairy diet (3 servings/day of milk, yogurt, or cheese; 1,200-1,300mg calcium/day).

In the weight loss study, 29 obese African American adults were placed on a 500 calorie-restricted diet, based on their baseline calorie needs, and were randomized to either the low dairy or high dairy diet (20). The average weight loss (pounds) for the high dairy group was nearly twice that of the low dairy group (24.2 vs 13.1); average fat loss (pounds) was more

than twice that of the low dairy group (20.0 vs 8.7) (20). Also, the average loss of lean body mass was significantly less in the high dairy group compared to the low dairy group. These findings support those from previous studies showing that consumption of 3 servings of dairy foods/day as part of a reduced-calorie diet increases weight loss (18,19).

In the weight maintenance study, 34 obese African American adults were placed on diets to maintain weight and were randomized to either the low dairy or high dairy diet (20). As expected, there were no significant changes in body weight over the 24 weeks. However, there was a shift in body composition (20). Compared to the low dairy group, those in the high dairy group experienced significant decreases in total body fat (5.4%), trunk fat (4.6%), insulin (14%), and blood pressure (-6.8/-4.25 mm Hg), as well as an increase in lean body mass (2.2%).

These findings are of significance considering that African Americans are at greater risk for obesity and consume less calcium and dairy products than the white population (20). Also, the findings support the recommendations of the National Medical Association Consensus Report that encourages African Americans to consume 3 to 4 servings of dairy foods/day to reduce the risk for chronic diseases, including obesity (21).

Other recent randomized clinical trials indicate that healthy, normal weight adults can increase consumption of calcium-rich dairy products without a change in body weight (22,23). In a one-year randomized intervention in 135 healthy normal weight women (ages 18-30 years), no significant differences in body weight, body fat, or lean body mass were found between women who consumed higher amounts of dairy foods to increase their calcium intake to medium (1,026mg/day) or high (1,131 mg/day) levels and those consuming their usual diets (742 mg calcium/day) (22). Throughout the intervention, the dairy groups had slightly higher, although not statistically significant, average caloric intakes than the control group (22).

A 48-week randomized clinical trial compared the weight loss results of 72 obese adults following three different

Recent controlled trials in overweight adults demonstrate that consuming 3 servings of dairy foods – milk, yogurt, or cheese – each day as part of a reduced-calorie diet increases body weight loss and improves body composition compared to reducing calories alone.



reduced-calorie diets: a high dairy diet that included 4 servings of dairy foods (milk, yogurt, or cheese) each day; a high dairy/high fiber/low glycemic index diet that included 4 servings of dairy/day; and a moderate dairy or standard diet that included 2 servings of dairy foods each day (23). After nearly one year (48 weeks), the participants in all three groups experienced significant body weight and body fat losses (23). However, there were no significant differences among the groups in loss of body weight, body fat, trunk fat, or changes in waist or hip circumferences. Those who closely adhered to the high dairy diets consumed 4 daily servings of dairy and about 100 to 140 more calories each day and still lost the same amount of weight as those who consumed 2 servings of dairy per day and fewer calories (23).

Another randomized clinical trial in overweight and obese adults who reduced their calories through diet and exercise found that consuming 3 to 4 servings of dairy foods/day (1,200-1,400 mg calcium/day) significantly reduced their body weight and body fat (24). However, weight and fat loss were not significantly different from that achieved with caloric restriction alone (24). This study shows that adults can consume 3 to 4 servings of dairy foods a day as part of a weight loss diet without jeopardizing their weight loss efforts.

Observational Studies. Unlike clinical trials, observational studies cannot prove a cause and effect relationship and can be subject to confounding. However, findings from observational studies often indicate the need for and provide direction for more carefully controlled clinical trials. Many observational studies of calcium and/or dairy intake and body weight/body fat are discussed in several reviews (11-15), including a previous issue of the *Digest* (17).

For example, results from the CARDIA (Coronary Artery Risk Development in Young Adults) study, which followed 3,157 African American and white adults aged 18-30 years for 10 years, indicate that increased intake of dairy foods may

The 2005 Dietary Guidelines for Americans states that "adults and children should not avoid milk and milk products because of concerns that these foods lead to weight gain."

protect overweight young adults from becoming obese or developing insulin resistance syndrome (also known as metabolic syndrome), which is associated with increased abdominal fat (25). Another observational study which included nearly 500 adults in the Quebec Family Study demonstrated that, after controlling for other variables, women consuming less than 600 mg calcium/day had significantly greater body weight, BMI, percentage body fat, fat mass, waist circumference and abdominal fat compared with those consuming 600 mg calcium or more (26). Dairy products provided almost 62% of the women's calcium intake. In this study, significant associations between dietary calcium and body weight and body composition were observed mainly in women.

A more recent observational study suggests that gender and race may influence calcium's effect on body weight or composition (27). This cross-sectional study examined the relationship between total calcium intake and body composition in sedentary African American and white men and women who participated in the HERITAGE Family Study (25). Low calcium intake was associated with increased body fatness, particularly in African American and white men and white women, but not in African American women.

Findings from a longitudinal study in the Netherlands led the researchers to speculate that there may be a threshold for calcium intake, above which calcium has little or no additional beneficial effect on body weight or body composition (28). In this study, there was only a weak inverse relationship between calcium intake and body composition. This may be explained by the high average calcium intake of 1,269 mg/day for men and 1,148 mg/day for women. No difference in BMI or body fatness was observed between middle (600 to 1,200 mg/day) and high (>1,200 mg/day) calcium groups (28).

A recent cross-sectional study in Iran that examined the relationship between dairy consumption and BMI in 462 adults found that those with the highest intakes of dairy foods had a significantly lower

BMI after controlling for confounding factors and were less likely to be obese than those with the lowest dairy food intakes (29). Recent longitudinal studies link a dietary pattern including reduced fat or lowfat dairy foods with a beneficial effect on body weight and body composition (30,31).

DAIRY AND WEIGHT MANAGEMENT IN CHILDREN AND ADOLESCENTS

For overweight children and adolescents, the goal is to slow the rate of weight gain while achieving normal growth and development (2). Maintaining a healthy weight throughout childhood may reduce the risk of becoming an overweight or obese adult (2,32). Compared to studies in adults, relatively little research has examined the relationship between calcium/dairy food intake and body weight/body fat in children and adolescents, and few of these studies include overweight children or adolescents (16).

Some observational studies have shown an inverse relationship between calcium and dairy intake and body weight and fat in children and adolescents (33-38). In a 3-year longitudinal study of 53 preschool children, those with higher intakes of calcium and dairy foods had a lower body fat at 70 months of age compared to children with lower intakes of calcium and dairy foods (33). In a follow-up study, a habitually higher intake of dietary calcium, primarily from milk and other dairy products, was related to lower body fat in 8-year old children (34). A 2-year prospective study in young children demonstrated that milk avoiders had low calcium intakes and higher BMIs compared with a population of milk drinkers (35). A statistically significant inverse association between the frequency of milk consumption and BMI was found in a cross-sectional study of 884 children, average age of 7.5 years, in southern Italy (36).

Findings from a cross-sectional study of 323 Asian and Caucasian adolescents (aged 9 to 14 years) in Hawaii found that total calcium and dairy calcium, but not



Further research is needed to determine if consumption of recommended servings of dairy foods as part of a nutritionally balanced diet helps to prevent and/or treat overweight in children and adolescents.

non-dairy calcium, were associated with lower body fat, after adjusting for other factors (38). For the entire group, one milk serving was associated with a decrease of approximately 0.78 mm in iliac skinfold thickness, whereas soda intake was positively associated with body weight (38). In the Asian children, one serving of milk was associated with a 1.89 mm smaller iliac skinfold thickness.

Other studies have shown that increasing calcium or dairy intake has no effect on body weight or fat in children and adolescents (39-42). A cross-sectional analysis of data collected over 3-1/2 years in 1,345 low-income preschool children in North Dakota found that weight change was not significantly related to intakes of several beverages, including milk, after adjusting for age, sex, energy intake, and other variables (39). In a cohort of 192 non-Hispanic white girls whose calcium intake was evaluated from ages 5 to 9 years, those who met calcium recommendations were not heavier, but had higher energy intakes and consumed almost twice the amount of milk compared to girls who consumed less than recommended calcium intakes (40). A longitudinal study of 178 normal weight girls aged 8 to 12 years at enrollment and followed through adolescence (~ age 18) found no evidence of a relationship between dairy foods or calcium intake and BMI or percent body fat (41). The researchers stated that the results refute the idea that dairy foods should be excluded during adolescence to avoid excess body weight and/or body fat accumulation (41).

The above findings are supported by a 2-year pilot study in 59 nine-year old girls randomly assigned to either a calcium-rich diet providing at least 1,500 mg of calcium/day, primarily from dairy foods, or their usual diet (42). Girls in the calcium-rich group had an average calcium intake of 1,656 mg/day, while those in the usual diet group consumed an average of 961 mg of calcium/day. Although the girls in the calcium-rich diet group consumed approximately 150 more calories per day, they did not have greater increases in body weight, BMI, or fat or lean mass

compared to the control (usual diet) group. The researchers concluded that calcium-rich diets do not cause excessive weight gain in pubertal girls while contributing positively to overall nutrition (42). The findings of this study corroborate those of earlier investigations (43-45).

A recent longitudinal study of more than 12,000 children aged 9 to 14 years found that children who consumed more than 3 servings of milk/day experienced gains in BMI greater than those who drank smaller amounts over the three year period (46). Quantities of 1% milk in boys and skim milk in girls were significantly associated with BMI gains, as was total calcium. However, when adjusted for total calorie intake, these associations were no longer statistically significant (46). The researchers concluded that calorie intake was the most important predictor of weight gain in this study (46).

CONCLUSION

Ongoing research is attempting to determine dairy foods' role in helping to achieve a healthy body weight and body composition in adults and children and to learn more about mechanisms involved in the dairy-body weight relationship. Research from *in vitro* and experimental animal studies suggests that dietary calcium and other dairy components (e.g., protein, branched chain amino acids, bioactives) may regulate energy metabolism and obesity risk (12-15,47). Based on the evidence to date, health professionals are encouraged to recommend adequate calcium intake, preferably from dairy foods, when counseling patients about weight management (48).

REFERENCES

1. U.S. Department of Health and Human Services. *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity*. Washington, D.C.: U.S. Government Printing Office, 2000. www.surgeongeneral.gov/library.

2. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *Dietary Guidelines for Americans, 2005*. 6th Edition. Washington, D.C.: U.S. Government Printing Office, January 2005. www.healthierus.gov/dietaryguidelines.
3. Hedley, A.A., C.L. Ogden, C.L. Johnson, et al. *JAMA* 291: 2847, 2004.
4. Flegal, K.M., B.I. Graubard, D.F. Williamson, et al. *JAMA* 293: 1861, 2005.
5. Olshansky, S.J., D.J. Passaro, R.C. Hershov, et al. *N. Engl. J. Med.* 352: 1138, 2005.
6. Moshfegh, A., J. Goldman, and L. Cleveland. *What We Eat in America, NHANES 2001-2002: Usual Nutrient Intakes from Food Compared to Dietary Reference Intakes*. U.S. Department of Agriculture, Agricultural Research Service, 2005. www.ars.usda.gov/foodsurvey.
7. Cook, A.J., and J.E. Friday. *Pyramid Servings Intakes in the United States 1999-2002, 1 Day*. CNRG Table Set 3.0. 2004. Beltsville, MD: USDA, ARS, Community Nutrition Research Group. www.ba.ars.usda.gov/cnrg.
8. U.S. Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, MD: U.S. Department of Health and Human Services. Office of the Surgeon General, 2004. www.surgeongeneral.gov/library.
9. Zemel, M.B. *J. Am. Coll. Nutr.* 20: 428s, 2001.
10. Teegarden, D., and M.B. Zemel. *J. Nutr.* 133: 243s, 2003.
11. Teegarden, D. *J. Nutr.* 133: 249s, 2003.
12. Zemel, M.B. *Lipids* 38: 139, 2003.
13. Parikh, S.J., and J.A. Yanovski. *Am. J. Clin. Nutr.* 77: 281, 2003.
14. Zemel, M.B. *Am. J. Clin. Nutr.* 79: 907s, 2004.
15. Zemel, M.B., and S.L. Miller. *Nutr. Rev.* 62: 125, 2004.
16. Huang, T.T.K., and M.A. McCrory. *Nutr. Rev.* 63: 71, 2005.
17. National Dairy Council. *Dairy Council Digest* 75(2): 7, 2004.
18. Zemel, M.B., W. Thompson, A. Milstead, et al. *Obes. Res.* 12: 582, 2004.
19. Zemel, M.B., J. Richards, S. Mathis, et al. *Int. J. Obes. Relat. Metab. Disord.* 29: 391, 2005.
20. Zemel, M.B., J. Richards, A. Milstead, et al. *Obes. Res.* 13: 1218, 2005.
21. Wooten, W.J., and W.P. Price. *J. Natl. Med. Assoc.* 96 (suppl): 1s, 2004.
22. Gunther, C.W., P.A. Legowski, R.M. Lyle, et al. *Am. J. Clin. Nutr.* 81: 751, 2005.
23. Thompson, W.G., N.R. Holdman, D.J. Janzow, et al. *Obes. Res.* 13: 1344, 2005.
24. Harvey-Berino, J., B.C. Gold, R. Lauber, et al. *Obes. Res.* 2005, In Press.
25. Pereira, M.A., D.R. Jacobs, Jr., L. Van Horn, et al. *JAMA* 287: 2081, 2002.
26. Jacqmain, M., E. Doucet, J.P. Despres, et al. *Am. J. Clin. Nutr.* 77: 1448, 2003.
27. Loos, R.J., T. Rankinen, A.S. Leon, et al. *J. Nutr.* 134: 1772, 2004.
28. Boon, N., L.L.J. Kappes, W.H.M. Saris, et al. *Am. J. Epidemiol.* 162: 27, 2005.
29. Mirmiran, P., A. Esmailzadeh, and F. Azizi. *Int. J. Obes.* 29: 115, 2005.
30. Drapeau, V., J.-P. Despres, C. Bouchard, et al. *Am. J. Clin. Nutr.* 80: 29, 2004.
31. Newby, P.K., D. Muller, J. Hallfrisch, et al. *Am. J. Clin. Nutr.* 80: 504, 2004.
32. Freedman, D.S., L.K. Khan, M.K. Serdula, et al. *Pediatrics* 115: 22, 2005.
33. Carruth, B.R., and J.D. Skinner. *Int. J. Obesity* 25: 559, 2001.
34. Skinner, J.D., W. Bounds, B.R. Carruth, et al. *J. Am. Diet. Assoc.* 103: 1626, 2003.
35. Rockell, J.E., S.M. Williams, R.W. Taylor, et al. *Osteoporos. Int.* 2004. Epub ahead of print, 19 p.

36. Barba, G., E. Troiano, P. Russo, et al. *Br. J. Nutr.* 93: 15, 2005.
37. Olivares, S., J. Kain, L. Lera, et al. *Europ. J. Clin. Nutr.* 58: 1278, 2004.
38. Novotny, R., Y.G. Daida, S. Acharya, et al. *J. Nutr.* 134: 1905, 2004.
39. Newby, P.K., K.E. Peterson, C.S. Berkey, et al. *J. Am. Diet. Assoc.* 104: 1086, 2004.
40. Fisher, J.O., D.C. Mitchell, H. Smiciklas-Wright, et al. *Am. J. Clin. Nutr.* 79: 698, 2004.
41. Phillips, S.M., L.G. Bandini, H. Cyr, et al. *Int. J. Obesity* 27: 1106, 2003.
42. Lappe, J.M., K.A. Rafferty, K.M. Davies, et al. *J. Am. Diet. Assoc.* 104: 1361, 2004.
43. Chan, G., K. Hoffman, and M. McMurry. *J. Pediatr.* 126: 551, 1995.
44. Cadogan, J., R. Eastell, N. Jones, et al. *Br. Med. J.* 315: 1255, 1997.
45. Merriam, M.J., E.J. Smart, N.L. Gilchrist, et al. *J. Nutr.* 39: 256, 2000.
46. Berkey, C.S., H.R.H. Rockett, W.C. Willett, et al. *Arch. Pediatr. Adolesc. Med.* 159: 543, 2005.
47. Zemel, M.B. *J. Nutr.* 133: 252s, 2003.
48. Schrager, S. *J. Am. Board Fam. Pract.* 18: 205, 2005.

D

RELATED RESOURCES

- www.nationaldairycouncil.org
 - The Healthy Weight Health Education Kit (click on Health Professional Resources, then Nutrition Education Resources, then Health Education Kits)
- www.healthyweightwithdairy.com
- www.assessyourdiet.webmd.com
- www.3aday.org

Coming Next Issue:

THE ROLE OF THE SCHOOL ENVIRONMENT IN CONTRIBUTING TO CHILDREN'S WELLNESS

ACKNOWLEDGMENTS

National Dairy Council® assumes the responsibility for this publication. However, we would like to acknowledge the help and suggestions of the following reviewers in its preparation:

- Marta Van Loan, Ph.D.
Research Physiologist
USDA, ARS,
Western Human Nutrition Research Center
University of California – Davis
Davis, CA
- Michael B. Zemel, Ph.D.
Professor of Nutrition and Medicine
Director, The Nutrition Institute
Department of Nutrition
The University of Tennessee-Knoxville
Knoxville, TN

The *Dairy Council Digest*® is written and edited by Lois D. McBean, M.S., R.D.

COPYRIGHT NOTICE

Copyright © 2005, NATIONAL DAIRY COUNCIL®
O'Hare International Center, 10255 West Higgins Road,
Suite 900, Rosemont, IL 60018-5616.

